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SUBJECT: DISCRETE RADIOACTIVE PARTICLE (DRP) CONSTRAINT RULE

The purpose of this memo is to bring you up to date on technical staff discussions regarding the planned DRP rulemaking. New information appears to make it very difficult to justify proceeding with the Commission approved rule plan.

In the early 1980s, increasing numbers of DRPs were observed on or near the skin of workers primarily in nuclear power plants. These small (< 2mm) particles have high specific activity (Beta) and when on or very near the skin produce a very localized high dose to a small volume of skin tissue that may result in a transient break in the skin with little health consequence.

The existing Part 20 skin dose limit of 50 Rem averaged over 1cm^2 is intended to apply to relatively uniform dose to a larger area of skin, and was selected to prevent deterministic damage to the skin that might compromise skin function or appearance. Because this limit did not seem to apply to DRPs on or very near the skin, the NRC established an interim guideline in Information Notice No. 90-48, that would require only reporting and mitigation if a DRP dose exceeded the existing 50 Rem over 1 cm^2 limit, and enforcement action would occur if the DRP beta emission exceeded 75 μCi-hrs (~300 Rads). In order to avoid DRP doses greater than 50 Rem and the resulting reporting requirement, licensees with DRP problems monitor workers frequently during the work shift, thus incurring additional external dose.

Brookhaven National Laboratory (BNL) was contracted to study the health effects of DRPs on the skin and the National Council on Radiation Protection and Measurement (NCRP) was given a grant to develop guidance on controlling DRP doses. The staff developed a rulemaking plan based on BNL findings and interim NCRP guidance.

In December of 1998, the Commission approved the staff's plan to develop a rulemaking to amend 10 CFR Part 20 to control dose to the skin from DRPs on or near the skin. The approved plan included establishing a 300 Rad over 1cm^2 constraint (action level) and a 500 Rad over 1cm^2 limit for DRP dose to the skin. (Staff had recommended a 1000 Rad over 1cm^2 limit to cap the constraint.) Since that time new information has become available to the staff that suggests the planned action is not advisable.

Unsolicited industry comment and technical input from Dr. John Baum, a consultant under contract to NRR have provided the following information:

1. Of all DRP events, fewer than 10% are on or sufficiently near enough to the skin to produce a unique, localized Beta dose having no large area health implications.

2. Most DRP events (<90%) are DRPs on clothing, hair or otherwise far enough away from the skin, and most likely moving, such that the dose to the skin is more uniform, spread over a larger area, and is more likely to be controlled by the existing 50 Rem skin dose limit.

3. A revision in the VARSKIN code, that calculates dose to the skin, and new calculations performed by Dr. Baum, show that a DRP as close as 0.4 mm from the skin can deliver a concentrated DRP dose to a small volume of skin that is less than the proposed 500 Rad to $1cm^2$ DRP dose limit, and still deliver more than 50 Rem to the next $1cm^2$ area, thus exceeding the existing skin dose limit.

4. New research reports that the shallow dose equivalent needed to produce a transient erethema (reddening) to the skin may be as low as 200 Rem.

5. An industry representative has observed that many licensees use 10-20% of any limit as an administrative guideline to avoid exceeding the limit. If the DRP dose limit were set at 500 rads over $1cm^2$, the actual operating limit could be as low as 50-100 Rads, thus losing the value of the 300 Rad Constraint.

The justification for proposing a 300 rad over $1cm^2$ constraint, or action level, was in large part to reduce the additional external dose incurred from frequent worker monitoring to avoid having to report a DRP dose that exceeded the existing 50 Rem skin dose limit. If 90 percent of DRPs are off the skin, and irradiating a relatively large area, the existing skin dose limit is in effect, and the constraint would only rarely be operative. Little relief from monitoring dose would occur.

For particles on the skin it now appears that in some cases a DRP dose could be within the 300 Rad DRP constraint and still exceed the existing 50 rem skin dose limit in the next annular square centimeter. For these reasons it is likely that creating a DRP constraint of 300 Rads would reduce monitoring for DRP only slightly if at all. Consequently the staff no longer believes that a DRP dose constraint is useful or justifiable.

Four possible alternatives for establishing controls to the dose to the skin from DRPs are as follows:

1. Propose a 500 Rad averaged over $1cm^2$ for DRPs <u>on or very near the skin</u>, and default to the existing skin dose limit of 50 Rem over $1cm^2$ for all other cases of skin contamination or irradiation including DRPs off the skin.

2. Propose that the skin dose limit for all exposure situations including DRPs on the skin be set at 50 Rads averaged over 10 cm^2. (increase the area over which the existing skin dose limit is averaged, and use it for all cases)

3. Propose a DRP limit of 50 Rad averaged over 10 cm^2 for all DRPs, on or off the skin and retain the 50 Rem over 1cm^2 for all other skin dose situations.

4. Use the existing skin dose limit of 50 Rem over 1cm^2 for all cases of shallow dose equivalent to the skin, including DRPs on the skin. For the special, and rare case of DRPs on the skin, provide an acceptable method for dose calculation in a revision to R.G. 8.36.

The advantages and disadvantages for these alternatives follows:

1. 500 Rad/1cm^2 for DRPs on or near skin. Retain existing 50 Rem/1cm^2 for all other skin doses.

   Advantages

   - For the few cases that DRPs on skin produce a transient break in the skin, and do not deliver > 50 Rem to next cm^2, the DRP limit is high enough to be consistent with the low level of risk to the worker.
   - The limit is not likely to be exceeded often so that the small regulatory burden is appropriate to the small risk associated with a transient break in the skin.
   - Consistent with NCRP recommendation.

   Disadvantages

   - Very little reduction in worker monitoring or associated external dose would result because most cases would still be limited by the 50 Rem/cm^2 limit.
   - For every case of a DRP on or very near the skin calculation of dose to the next cm^2 would be necessary to assure compliance with 50 Rem/cm^2.

2. Set single skin dose limit at 50 Rem averaged over 10 cm^2 for all skin doses. (Increase area over which existing skin dose limit is averaged; effectively raising limit by factor of 10 for nonuniform dose.)

   Advantages

   - Simple and practical to measure.
   - Would decrease need for monitoring and reduce associated external dose.
   - Would permit 500 Rad to central cm^2, and 0 Rad to next 9 cm^2.

- Would permit up to 50 Rem to each of 10 cm^2.
- Consistent with NCRP recommendation for DRPs.

Disadvantages

- Would permit infrequent visible but transient breaks in the skin with little health effect.
- Might now permit occasional erethema (reddening) of areas of the skin.
- Staff is not aware of strong technical support for changing existing skin dose limit.

3. Set DRP limit of 50 Rad/10 cm^2 for all DPRs, on or off the skin and retain the existing 50 Rem/cm^2 for all other skin dose situations.

Advantages

- Relieves monitoring burden and reduces unnecessary external dose.
- Consistent with NCRP.
- Few licensees are effected.

Disadvantages

- Difficult to explain how DRP on skin that exposes one or more cm^2 to greater than 50 Rem is acceptable if average of highest 10 cm^2 is less than 50 i.e. Some cases would exceed existing skin dose limit.

4. Use existing skin dose limit of 50 Rem/cm^2 for all cases of shallow dose equivalent to the skin.

Advantages

- Easiest regulatory action.

Disadvantages

- Provides no relief to monitoring burden or reduction in external dose.
- Ignores BNL research findings and NCRP recommendations.

Discussion with NMSS and NRR technical staff indicate that option C is preferred but that B might also be acceptable. Dr. John Baum has been asked to review ICRP reports 26,60 and Publication 35, and to provide technical guidance on the definition of Shallow Dose Equivalent and occupational skin dose limit, and the practical implications of changing areas over which

dose is measured. This issue is also being reviewed by the technical working group, and I expect that we will be able to make recommendations for appropriate regulatory action by the end of August 1999.